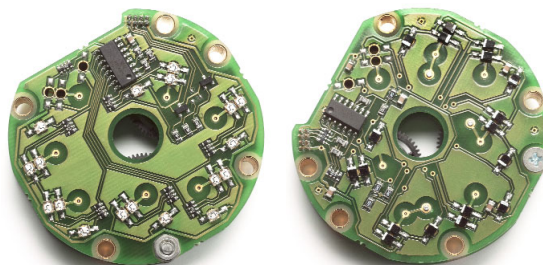


Agilent AEAS-84AD 14/12 Bit Multi-turn Encoder Module Data Sheet



General Description

The AEAS-84AD provides all functions as an optoelectronic-mechanical unit in order to implement with AEAS-7000 an absolute multi-turn encoder with a combine capacity of up to 30 bits.

The unit consists of an IR-LED circuit board, a phototransistor (PT) circuit board, and 6 or 7 code wheels arranged in between the PCBs.

Specifications

The multi-turn unit is available in the following versions:

- 12-bit solid shaft
- 14-bit solid shaft

Applications

- Major component of Multi-turn housed encoder
- Cost effective solution for direct integration into OEM systems
- Linear positioning system

Features

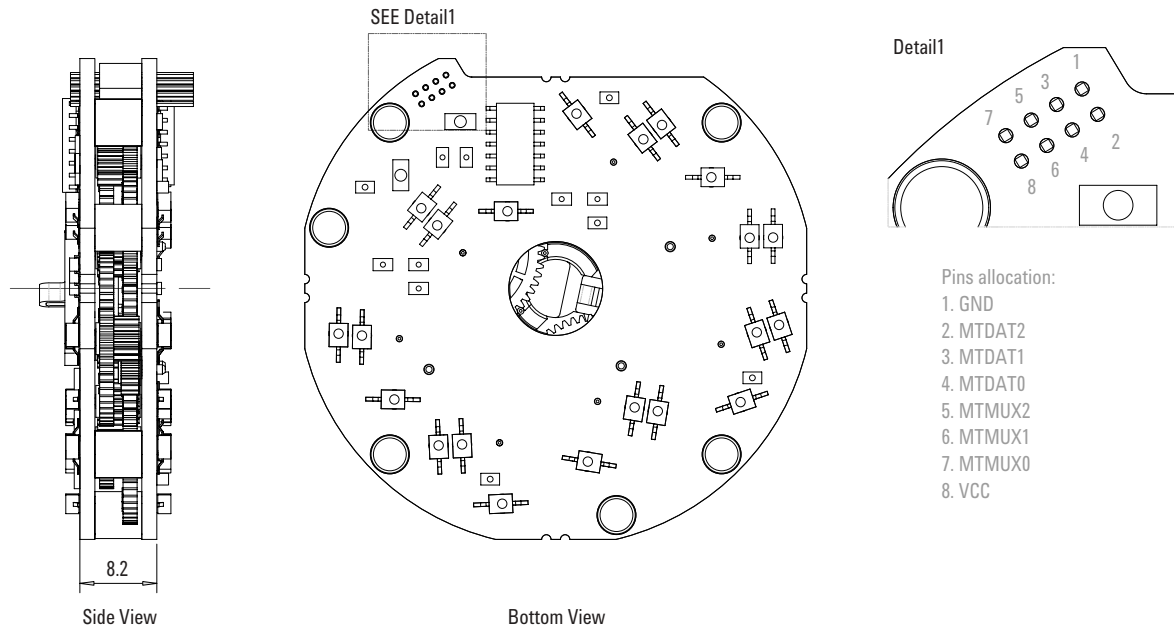
- 16384 (14bits) and 4096 (12bits) revolution count versions
- Optical, absolute multi-turn assembly with max. Ø55 mm and typical height 11.9 mm.
- Operating temperatures of -40°C to +85°C
- Mechanical coupling by means of gearwheels with module of 0.3
- Operating speeds up to 12,000 rpm
- A 2x4-pole pin strip for power supply and signals
- 5V +/-10% power supply with low power consumption
- Code wheel-like multiplexing of the digital position data

Benefits

- No battery or capacitor required for number of revolution counting during power failure
- Immediate position detection on power up



Pinning



Note: 3rd angle viewing

Example of matching connector: MPE GARRY 521 Series, No. BL21-43GGG-008

Figure 1. Pin Configuration

Block Diagram and Detailed Description

In the following descriptions, the I/O pins are enclosed by a box, e.g., MTMUX[2:0].

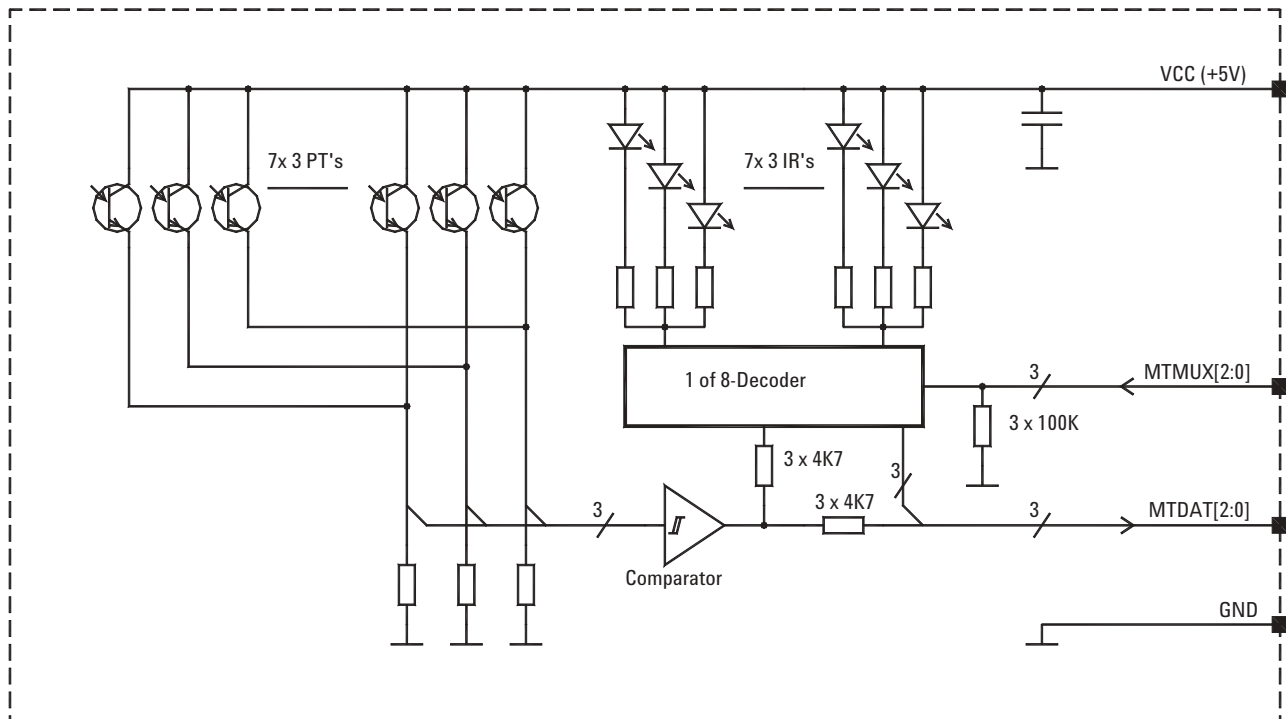


Figure 2. Block Diagram

Multiplexing and Position Data

Each of the 1:4 reduced 7 code wheels generates a 3-bit code, from which the 14-bit Gray code can be generated as position data through V-bit processing.

The 3-bit code is identical electrically for all code wheels, only the projection on the mechanical angle (the revolutions) is different according to the 1:4 divisions.

The code and the data bits and V-bits to be generated are shown in the following diagram for the code wheel 1:

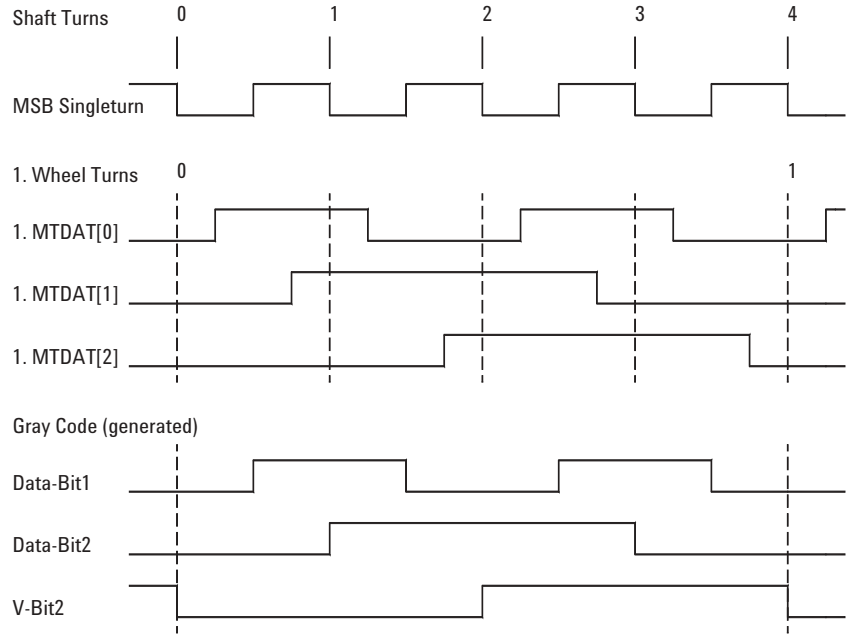


Figure 3. Multiplexing Diagram for gear wheel 1

The 3-bit codes of the code wheels 1 to 7 are output on **MTDAT[2:0]** de-multiplexed with **MTMUX[2:0]**. Here, the binary value on **MTMUX[2:0]** corresponds to the code-wheel number (1 = code wheel 1, 2 = code wheel 2, etc.). The configuration is displayed with the value “0.”

The following table shows the assignments:

Table 1. Demultiplexing Diagram for all gear wheels

Bin/Dec	MTMUX[2:0]	MTDAT[2]	MTDAT[1]	MTDAT[0]
001 / 1		3-bit code wheel 1		
010 / 2		3-bit code wheel 2		
to		to		
111 / 7		3-bit code wheel 7		
000 / 0		always 1	0 = 12 bit 1 = 14 bit	1 = MU1xSS

Gray code-generation

For the readout schematic of the multi-turn code gears, i.e. with the user's micro-controller, there must be a logical replication of the V-bit multiplexers. This can be done by a bit manipulation or by look up tables. Care needs to be taken with the real time readout conditions.

The procedure is as follows :

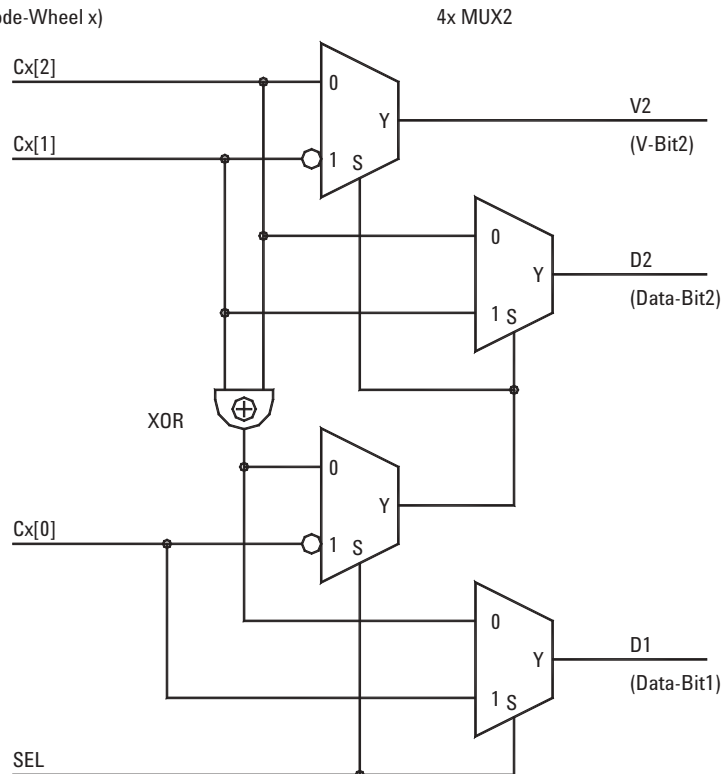
1. The 3 bits (MTDAT[2:0] of each gear (C1[2:0] bits C7[2:0]) are continuously de-multiplexed. Thus there are maximal 3bits x 7gears = 21Bit AEAS-84AD-Data in parallel.
2. Synchronous to the readout of the AEAS-7000 sensor, those AEAS-84AD bits (depending on the MSB bit (1.SEL-bit) of the AEAS-7000) needs to be complemented to the complete Gray code word (cascading).
3. The bit change of the complete Gray code will be synchronized by the AEAS-7000 and thus electronically eliminating gear play.

The logic diagram for ONE gear is shown in the following diagram (V-bit-Multiplexer), Figure 4.

Logic Diagram

From MTDAT-Demux

(Code-Wheel x)



Truth Table

SEL	Cx[0]	Cx[1]	Cx[2]	D1	D2	V2
0	0	0	0	0	0	0
0	1	0	0	0	0	0
1	1	0	0	1	0	0
1	1	1	0	1	0	0
0	1	1	0	1	1	0
0	0	1	0	1	1	0
1	0	1	0	0	1	0
1	0	1	1	0	1	0
0	0	1	1	0	1	1
0	1	1	1	0	1	1
1	1	1	1	1	1	1
1	1	0	1	1	1	1
0	1	0	1	1	0	1
0	0	0	1	1	0	1
1	0	0	1	0	0	1
1	0	0	0	0	0	1

Figure 4. Logic Diagram and Truth Table for one of the gear

The following diagram shows the cascading of the V-bit-Multiplexer of all gears. The outputs are the 14bits Gray code in parallel.

The MSB of the complete code is dependant on the total resolution of the system. It can be used in steps of 2 bits (14Bit,12Bit,...etc). Unused higher bits should be masked to logical zero.

With the data-multiplexer IC version of the multi-turn encoder module, the data multiplexer IC will perform the complete driving and data processing of the encoder units while maintaining all time constraints.

There is an IC available to combine both the AEAx-7x00 13/16-bit single turn component and the AEAx-84AD 12/14bit multiturn module into one-single powerful multi-turn absolute encoder. This one-stop solution enables the design of a high-end absolute encoder with minimum component count at integration level. Figure 6 shows an application example of integration of single-turn absolute encoder and multiturn module using MUIC.

Note:
To simplify the synchronization with singleturn absolute encoder(e.g. AEAS-7000), the total solution has been embedded into a single chip - MUIC. Please refer to the Ordering Information for this device.

V-Bit-Multiplexer-Cascade

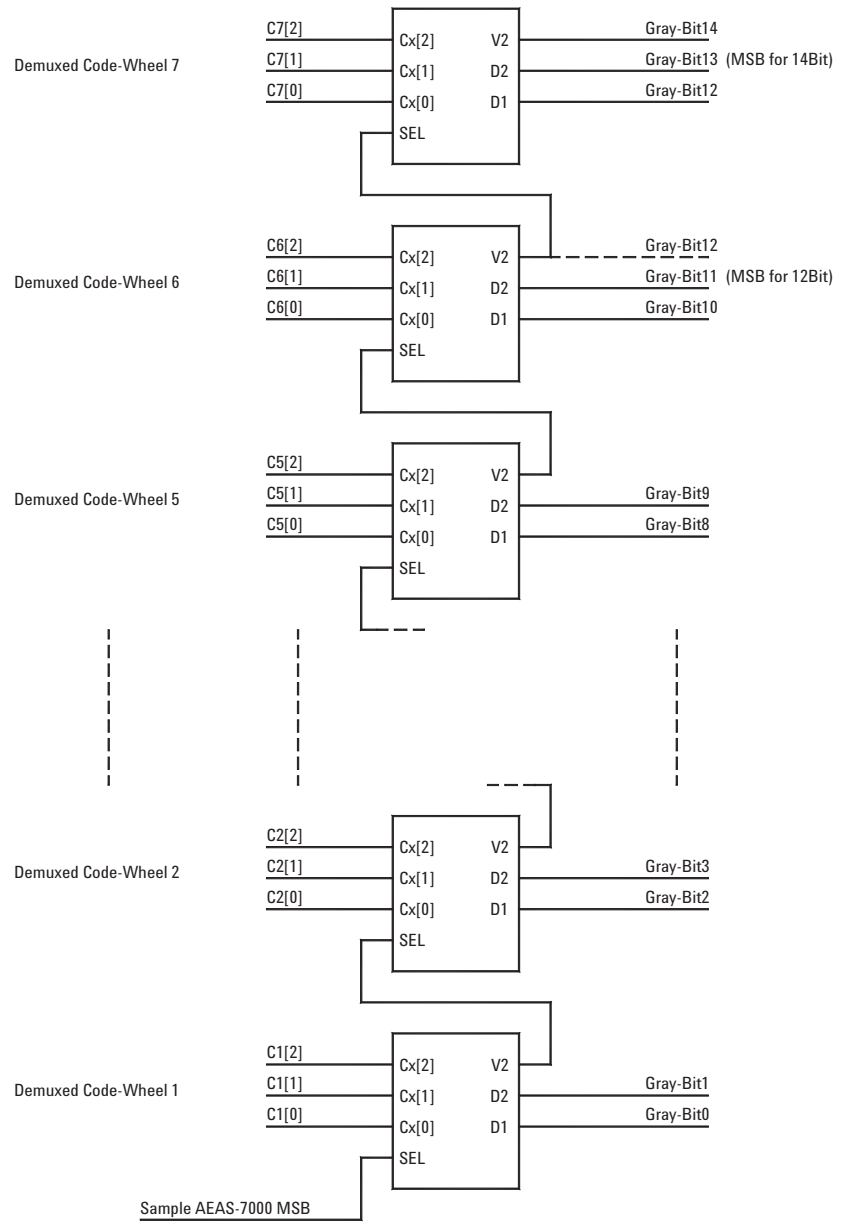


Figure 5. The cascading of V-bit-Multiplexer of all gear wheels

Application Example of Multiturn Absolute Encoder

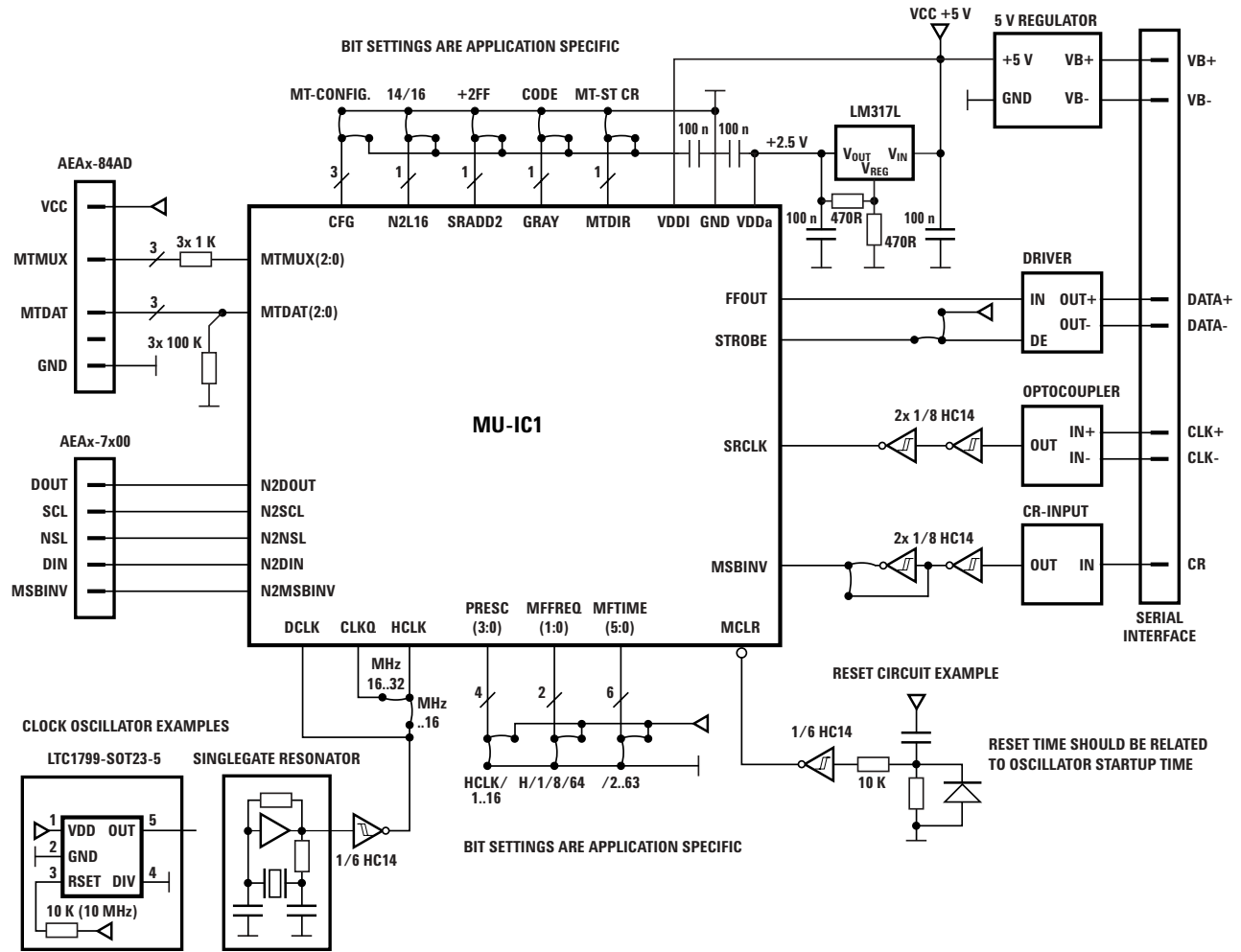


Figure 6. Application example of integration of single-turn absolute encoder module and multiturn module using MUIC.

Electrical Specifications

Absolute Maximum Ratings

Symbol	Parameter	Limits	Units
VCC	DC Supply Voltage	-0.3 to +6.0	V
V _i	Input Voltage	-0.5 to +5.5	V
V _o	Output Voltage	-0.5 to +VCC +0.5	V
%RH	Moisture Level (Non-Condensing)	85	%
T _{stg}	Storage Temperature	-40 to +100	°C

Note : This device meets the ESD ratings of the IEC61000-4-2 HBM Level 4 (8KV)

Recommended Operating Conditions

Symbol	Parameter	Values	Units
VCC	DC Supply Voltage	+4.5 / +5.0 / +5.5	V
T _{amb}	Ambient Temperature	-40 to +85	°C
t _{DMUXRD}	Delay Multiplex Read	64	µs
S _{RPM}	Encoder Shaft r.p.m	max 12,000	1/min

DC Characteristics

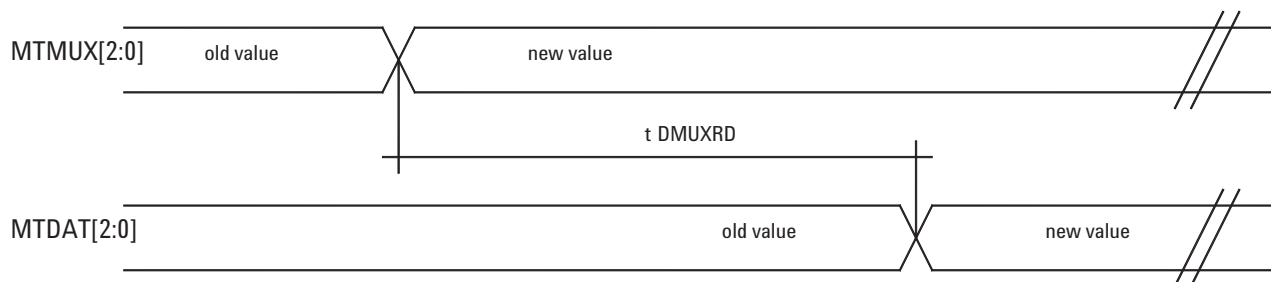
VCC = 4.5 to 5.5 V / T_{amb} = -40 to +85°C

Symbol	Parameter		Values			Units
			Min	Typ.	Max	
V _{OH}	MTDAT[2:0] Output High Voltage (10K Pull-up)	I _{OH} = -50µA	4.0			V
V _{OL}	MTDAT[2:0] Output Low Voltage (4K7 Series-R)	I _{OL} = 50µA			0.4	V
V _{IH}	Input High Voltage	VCC=4.5V VCC=5.5V	3.2 3.9			V
V _{IL}	Input Low Voltage				0.8	V
I _{IL} / I _{IH}	MTMUX[2:0] Input Current., VIN=VCC or 0V	100K Pull-down	-10		100	µA
I _{CC}	VCC Supply Current			10	20	mA

Timing Characteristics

VCC= 4.5 to 5.5V / T_{amb} = -40 to +85°C

Symbol	Parameter		Values			Units
			Min	Typ	Max	
t _R / t _F	Input Transition Rise-/Fall-Time	0.8V / 3.0V			500	ns
t _{DMUXRD}	Delay Multiplex Read				57	µs
S _{RPM}	Encoder Shaft r.p.m				12K	1/min



Application Note

The encoder is mechanically fixed by means of holes in adapters, which accommodate M3 threads. The encoder has 2 adapters for attaching in a $3 \times 120^\circ$ and $4 \times 90^\circ$ arrangement (for details see the mechanical drawings in the following page).

The mechanical coupling of the encoder shaft is realised by means of gearwheels with a module of 0.3, 14 teeth. The zero positions of the coupling wheels are locked with a plastic plug for alignment to the AEAS-7000, with the coupling wheel being able to compensate for an angle error of about $\pm 7^\circ$.

The electrical connection is realized by means of a 2x4 pin strip (1.27mm pitch), which is plugged into a corresponding female connector.

The encoder is attached with a plastic plug that locks the absolute zero position. During the mating of the gearwheel and the encoder coupling wheel it may be necessary to align the teeth of the gears for proper matching. The plastic plug can be removed upon integration with the gearwheel.

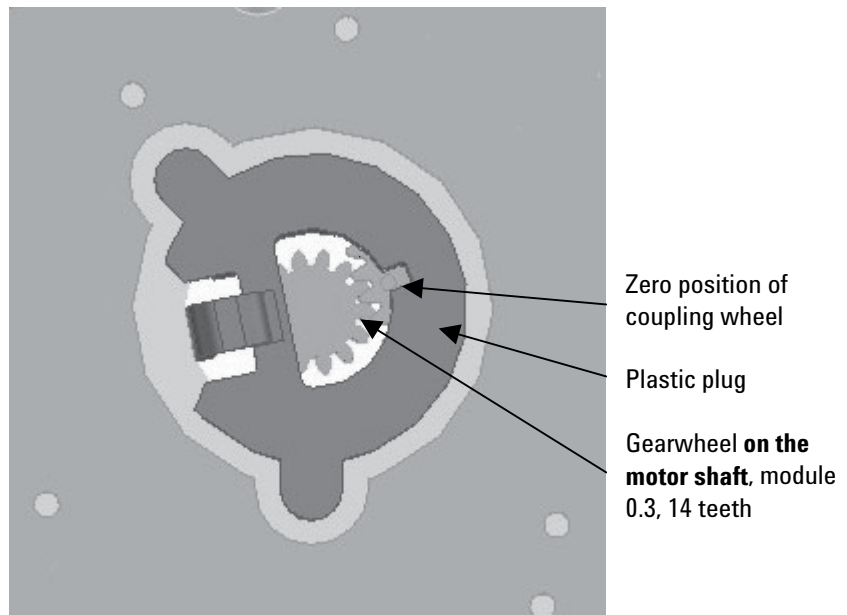
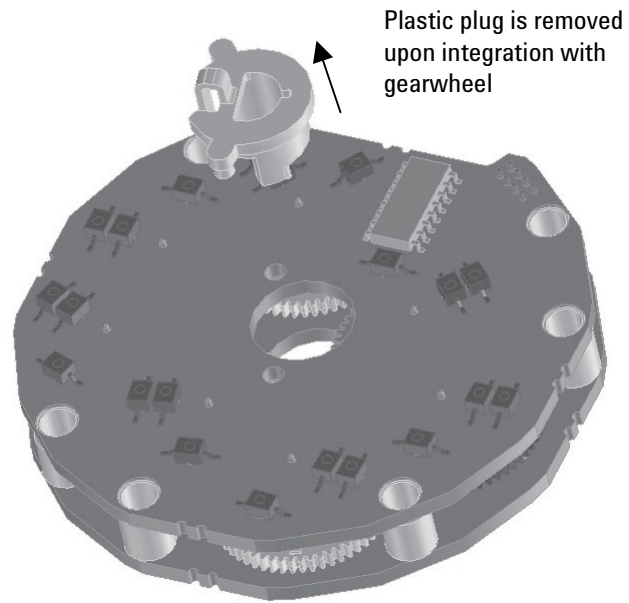
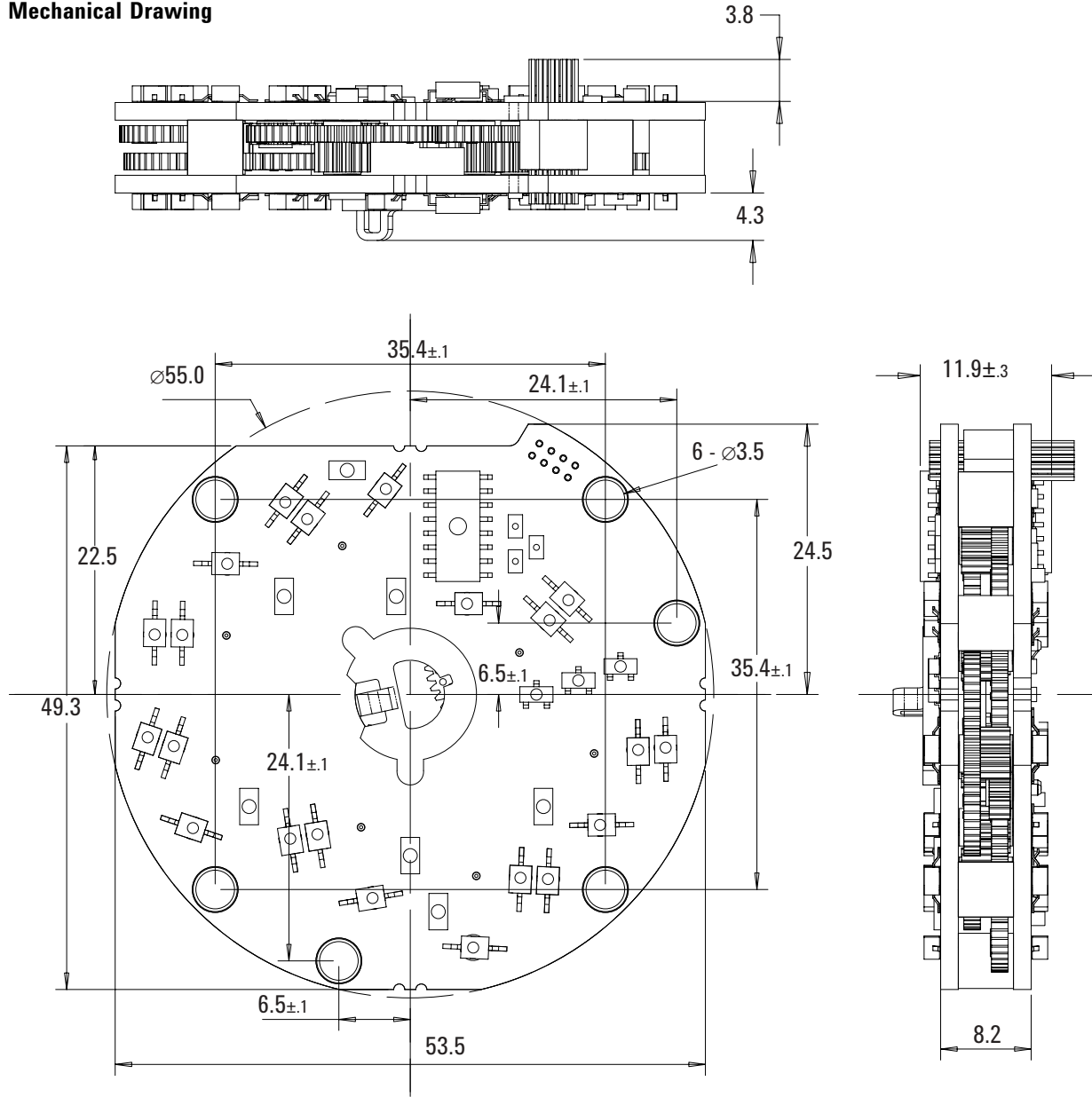


Figure 7. Mechanical coupling with Multiturn Encoder Module

Mechanical Drawing



(Dimensions are in millimeters)

Figure 8. Package dimensions

Ordering Information

AEAS-84AD-LBSC0 multi-turn, solid shaft, serial, 12 bit

AEAS-84AD-LBSF0 multi-turn, solid shaft, serial, 14 bit

Ordering information for MUIC:

MUIC1-V0 leaded, industrial temperature range +85°C

MUIC1-V0-X79 lead-free, industrial temperature range +85°C

Note: The manufacturer contact for the above MUIC part numbers is as follows:

OPTOLAB Microsystems AG
Konrad-Zuse-Str.14
DE-99099 Erfurt / Germany
Phone: +49-361-55144-0
Fax: +49-361-55144-50
Email: agilent@optolab.com

[www.agilent.com/ semiconductors](http://www.agilent.com/semiconductors)

For product information and a complete list of distributors, please go to our web site.

For technical assistance call:

Americas/Canada: +1 (800) 235-0312
or (408) 654-8675

Europe: +49 (0) 6441 92460

China: 10800 650 0017

Hong Kong: (+65) 6756 2394

India, Australia, New Zealand: (+65) 6755 1939

Japan: (+81 3) 3335-8152(Domestic/International), or 0120-61-1280(Domestic Only)

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